REMARKS

Review and reconsideration on the merits are requested.

Claims 22, 24, 26, 28, 30, 32, 34 and 35 remain active and under examination with claims 34 and 35 being rewritten in independent form.

Turning initially to the objections to the drawings, Applicants attach for the Examiner's consideration a Fig. 19 and a Fig. 20 which they would propose to add as new drawings.

As shown in Fig. 3 of U.S. Patent 5,527,101 Kato et al, the method for measuring the DAS "N" distance is well known to one of ordinary skill in the art. Fig. 20 shows a DAS "N" as the distance between secondary arms on both sides of the stem of a dendrite in the same photograph of Fig. 19 taken using a light microscope of 50X.

The Examiner's approval of the drawings would be appreciated.

The prior art: U.S. Patent 1,414,662 to Morgan (Morgan); U.S. Patent 5,527,101 to Kato et al (Kato).

Claims 34 and 35 have been rewritten in independent form; these claims were indicated to be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. Paragraph 5 of the Action of December 1, 2003.

The rejections:

With the cancellation of claims 23, 25, 27, 29 and 31, the obviousness rejection over Morgan would be mooted. Similar remarks apply to the rejection of claim 33 over Morgan in view of Kato.

However, for purposes of discussion, though claim 22 represents a combination of original claims 22/23 with additional amendment, Applicants assume that the Examiner would reject the remaining claims except for claims 34 and 35 (allowable) over Morgan in view of Kato.

They traverse such rejection for the reasons later presented.

Claim Amendments

In amended claim 22, the recitation "A light alloy wheel for a vehicle integrally cast by a low-pressure casting method" finds support in the recitation of original claim 23, and the recitation "and having no scratch and deformation on said design portion" finds support at page 22, lines 1-5 of the specification.

Amendments to the specification

With the addition of Figs. 19 and 20, Applicants have amended the specification. See page 9.

Traversal

Because the important features of the present claims which distinguish the prior art are recited in amended claim 22 of the present application, Applicants initially discuss patentability (unobviousness) only with respect to amended claim 22.

Amended claim 22 of the present application calls for:

> "A light alloy wheel for a vehicle integrally cast by a low-pressure casting method comprising a disc portion comprising a hub portion and a design portion and a rim portion, said design portion having substantially as-die-cast spoke portions having at least partially taper angles of less than 5.0° and at least part of said spoke portions having a dendrite, and having no scratch and deformation on said design portion."

Major distinguished features of amended claim 22 reside in the fact that:

(1) the light alloy wheel for a vehicle is integrally cast by a low-pressure casting method;

(2) at least part of the spoke portions thereof have a dendrite, and

(3) it has no scratch and deformation on the design portion.

In general purpose cast materials, scratches on the surface thereof do not generally cause any problem. However, in a light alloy wheel for a vehicle created with priority on design, it is necessary to cast the wheel free from casting defects, e.g., without any scratches. Accordingly, to satisfy this very critical requirement, even in a low-pressure casting method, the use of a specified device on a casting apparatus such that the reduction of the die-clamping force by the cylinder is preferably carried out by reducing a piston-lowering hydraulic pressure of the cylinder to zero over a time period of 0.05 seconds or more while a constant piston-elevating hydraulic pressure is applied to the cylinder (as disclosed in the present specification) makes it possible to industrially produce for the first time a light alloy wheel for a vehicle having no scratches caused by die casting, even at taper angles of less than 5.0° among the spoke portions, by separating the cast wheel from the stationary lower die while elevating and holding the movable upper die in parallel therewith.

The Examiner stated in the second paragraph, lines 2-6, at page 4 of the Office Action, that:

> "This angle generally ranges from 1 degree to 3 degrees as a minimum taper to allow the product to be removed from the mold or die without damage to either. Therefore, it would have been well-known to those in the wheel casting art that since the minimum taper angle of the spokes could be as little as 1 degree, an angle of 3.5 degrees or less would have been obvious as desired given the particular use of the wheel and the visual impression desired.

Applicants respectfully submit that the above discussion by the Examiner would relate to the taper angle in general technology of die casting, as discussed in Applicants' previous response of August 23, 2003, at pages 11-14. Specifically, such discussion would relate to die casting which is carried out using a pressure chamber connected to a die cavity so that molten metal is forced to flow into the die cavity. Such discussion would not, Applicants respectfully submit, relate to technology concerning that at issue in the present application, namely a wheel comprising a design portion having as-die-cast spoke portions with at least part of the spoke portions having at least partially tapered angles of less than 5° and with a DAS (dendrite arms spacing) value in the hub portion smaller than the maximum DAS value in the rim portion. The Examiner is respectfully requested to refer to page 17, lines 10-12 of the present specification.

Further, the Examiner states in paragraph 6, lines 3-9 of the Office Action that:

> "[I]t is felt that those of ordinary skill in the art would readily find a taper angle of less than 3.5 degrees for the spoke to be obvious based on the common knowledge in the casting art...However, it should be pointed out that the use of a taper for cast articles would apply to many different forms and different types of casting methods beyond what is shown in the Handbook."

The above language implies that the Examiner considers the low-pressure casting method disclosed in the present application is simply a conventional low-pressure casting method. However, this certainly is not the case, as will now be explained using Fig. A attached hereto. While Applicants appreciate that they are not claiming a low-pressure casting method per se in the present application, nonetheless it is believed that the low-pressure casting method disclosed in the present application is clearly relevant on the issue of obviousness since it sets the

differences between the present invention, Morgan and Kato and is recited in claim 22 as now amended.

Fig. A attached hereto shows a cross-sectional view of one example of the main portion of a high-pressure die casting apparatus. In high-pressure die casting, it is necessary to press a stationary die 2 against a movable die 3 at high pressure so that the two dies do not slip off each other, and, accordingly, the clearance between a guidepost 4 and a sliding part 5 is designed to be very small. Also, since a melt is injected into a die cavity at high pressure in a short time, the die temperature is much elevated so that dimensional changes due to thermal expansion of the die are negligibly small.

Another reason for not elevating die temperature is that the melt is forced to flow into a sleeve by a plunger 6, so that a melt-holding furnace is placed at a position distant from the die, that is, in conventional high pressure die casting, the melt-holding furnace is placed at different position from the casting apparatus thereof, whereby a ladle 7, or the like, carries the melt at every cycle of casting to the sleeve, and, accordingly, the die temperature is not elevated. This is quite different from the case of low-pressure die casting per the present invention, in which the melt-holding furnace is placed immediately below the die. As a consequence, thermal expansion of movable die 3 hardly occurs so that the movable die can slide freely even though the clearance of sliding part 5 is small, whereby the movable die can be opened almost at a right angle to the butt surface against the stationary die. Thus, it is possible to withdraw the cast product from the die without any defects even if the taper angle is 1-3°.

In this regard, it should be specifically noted that in such a conventional high-pressure die casting method, since the melt solidifies in a short time, a cast product which is thin, such as wheel, will not form a metallic structure having a dendrite phase.

In contrast to the apparatus used for a high-pressure die casting method as described above, a low pressure die casting apparatus has a structure as shown in Fig. 10(a) of the present application. Since a melt flows into a cavity of the lower die under low pressure and at low speed, the injection pressure of the melt is low, and the necessary time for charging the melt is long, so that it is necessary to elevate the die temperature and to maintain it at a high temperature so as to not allow the melt to solidify in the die cavity portion.

Thus, heat is conveyed to movable platen 14 via movable upper die 12, thereby spreading the width of guidepost 15 fixed to movable platen 14, while the width of guide 16 is not so much spread, because heat is not conveyed to upper platen 13. Accordingly, the clearance between guidepost 15 and guide 16 should necessarily be more than several millimeters to allow guidepost 15 to slide. Thus, movable platen 14 is in a state of simply hanging from upper platen 17 by four guideposts 15. Also, the clearance is so large that it is difficult to perform die-opening operations while holding the movable die horizontally, and, accordingly, there occurs a problem such that the cast product will be damaged at the time of withdrawing the solidified wheel from the die unless the taper angle is more than 6°.

Accordingly, Applicants respectfully submit, in light of the above discussion, that the feature of "a taper angle of a range of 1-3 °" which the Examiner finds generally ranges from 1 degree to 3 degrees as a minimum taper, which the Examiner uses to support the conclusion that

it would have been well known to those in the wheel casting art that an angle of 3.5 degrees or less would have been obvious as "desired given the particular use of the wheel and the visual impression desired" does not necessarily or inherently flow from the use of a low-pressure casting method as called for in claim 22 and dependent claims therefrom which are rejected.

Morgan certainly describes at page 1, left column, in lines 33-34 that:

"The wheel comprises a felly 10, hub 11 and spokes 12 all cast integral," and at left column, lines 40-44 that:

"The hub projects at both sides of... the spokes 12 are continued out to the outer wall 15 of the felly as shown Figure 1 and 6," respectively, thus teaching a cast wheel comprising a hub, spokes and a rim (an outer wall).

Morgan also describes at page 1, left column, in lines 45-47 that:

"The spokes are U-shape in cross section, the open face being at the rear or inner side, and the felly which is also open at the rear,....."

apparently with references to with Fig. 4, which shows the actual states of the cross sectional view of spoke 12 having an open face being at the rear side and a taper (Fig. 4) in the same manner as disclosed in the present application.

Despite the above disclosure in Morgan, quite clearly Morgan fails to teach or suggest a cast metal wheel which is a light-alloy wheel as claimed in the present application. Further, Morgan is completely silent regarding any details on the taper angle thereof. Finally, Morgan is completely silent regarding any technical features regarding the method necessary to produce such a light-alloy wheel, and particularly one having no scratches or deformation on the design

portion as now claimed, Morgan, merely reciting the shape of the wheel in general as above discussed.

In contrast to Morgan, in accordance with the present invention, the object of the present invention is to provide a light-alloy wheel for a vehicle which is integrally cast by a low-pressure casting method. Quite clearly Morgan does not teach or suggest (enable one of ordinary skill in the art how to practice) a method for casting a wheel comprising a design portion having as-die-cast spoke portions having a small taper angle of less than 5.0°, an important aspect of the present invention which is not easy to achieve following conventional prior art methods.

As a consequence, Applicants respectfully submit that one of ordinary skill in the art, referring to Morgan, would find no motivation in the art relied upon to reach the invention of amended claim 22 and, accordingly, amended claim 22 of the present application is not obvious over Morgan.

Kato discloses a DAS at column 2, lines 40-42:

> "As an indication of a size in a microstructure of a casting of an aluminum casting wheel, a dendrite arm spacing (DAS) is measured,"

and gives a low pressure casting method using aluminum alloy as is disclosed in the present invention as a comparison Example at col. 4, lines 26-30 with the statement:

> "Also, the number "2" in the first position represents the conventional vehicle wheel according to a low pressure casting method as a comparison example and similarly, "3"...

together with showing that the DAS values of the middle portion (p2) of the disk and the rim carrying portion (p3) of the disk portion of the wheel expressed by Sample Nos. 2-1-2 and 2-1-3

obtained by low pressure casting in Table 1, which correspond to the spoke portions, are 40 μm and 37 μm, respectively, which are not less than 30 μm as indicated by the Examiner.

Thus, Kato merely teaches that DAS values vary in terms of size with the respective parts in a vehicle wheel. Kato is, however, silent regarding any taper angle, which is a very important characteristic in the present application. Specifically, in Table 1, Kato discloses the DAS values of Samples Nos. 1-1a-1 to 1-1a-8 at the respective parts (p1 to p8) (see Fig. 5) of a vehicle wheel obtained by casting under pressure using a casting device as shown in Fig. 1. Kato further discloses the DAS values of Sample Nos. 2-1-1 to 2-1-8 at the respective parts of a vehicle wheel obtained by low pressure casting as a comparison Example and the DAS values of Samples Nos. 3-1-1 to 3-1-8 at the respective parts of a vehicle wheel obtained by gravity casting also as a comparison Example. Thus, Kato merely teaches that vehicle wheels obtained by these casting methods have dendrite phases at the respective parts (p1 to p8) of a vehicle wheel, but Kato is silent regarding any technical means to obtain a vehicle wheel comprising a design portion having as-die-cast spoke portions having a small taper angle.

Accordingly, Applicants respectfully submit that one of ordinary skill in the art, considering the teaching of Morgan and Kato, would find no motivation to reach the invention of amended claim 22, even assuming that the shape of a die were simply made to have a taper angle of less than 5.0° in the casting method of Kato and, accordingly, amended claim 22 of the present application is not obvious over the combination of Morgan and Kato.

With respect to claims 24, 26, 28, 30 and 31, each of which depends from amended claim 22 of the present application, it is believed that the patentability of these claims is clear from the above discussion.

Withdrawal of all rejections and allowance is requested.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

As an interview summary, Applicants in a telephone interview on March 24, 2004, simply questioned the Examiner what type of drawing the Examiner was looking for. The Examiner responded that a very simple drawing would suffice. It is hoped that the present drawings meet the Examiner's requirement.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,

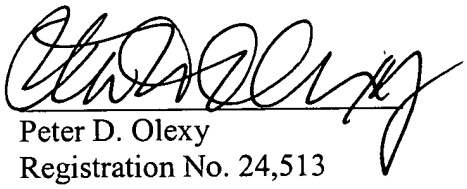

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Fig. A

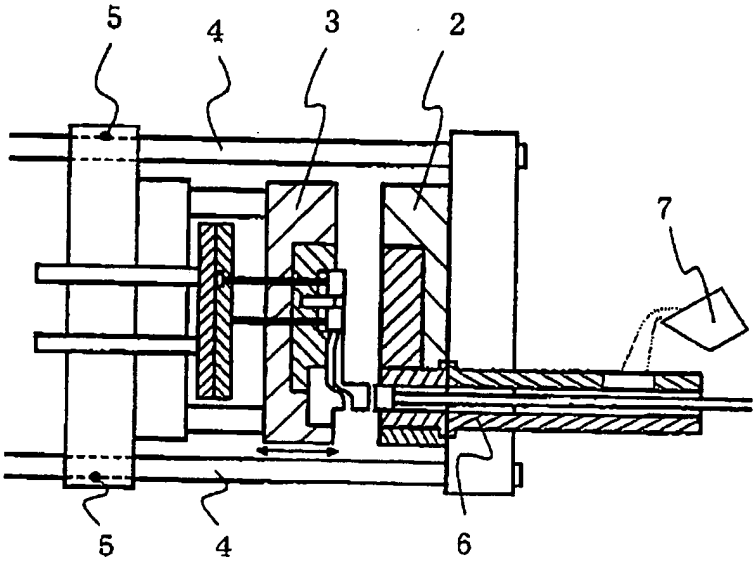

Fig. 19

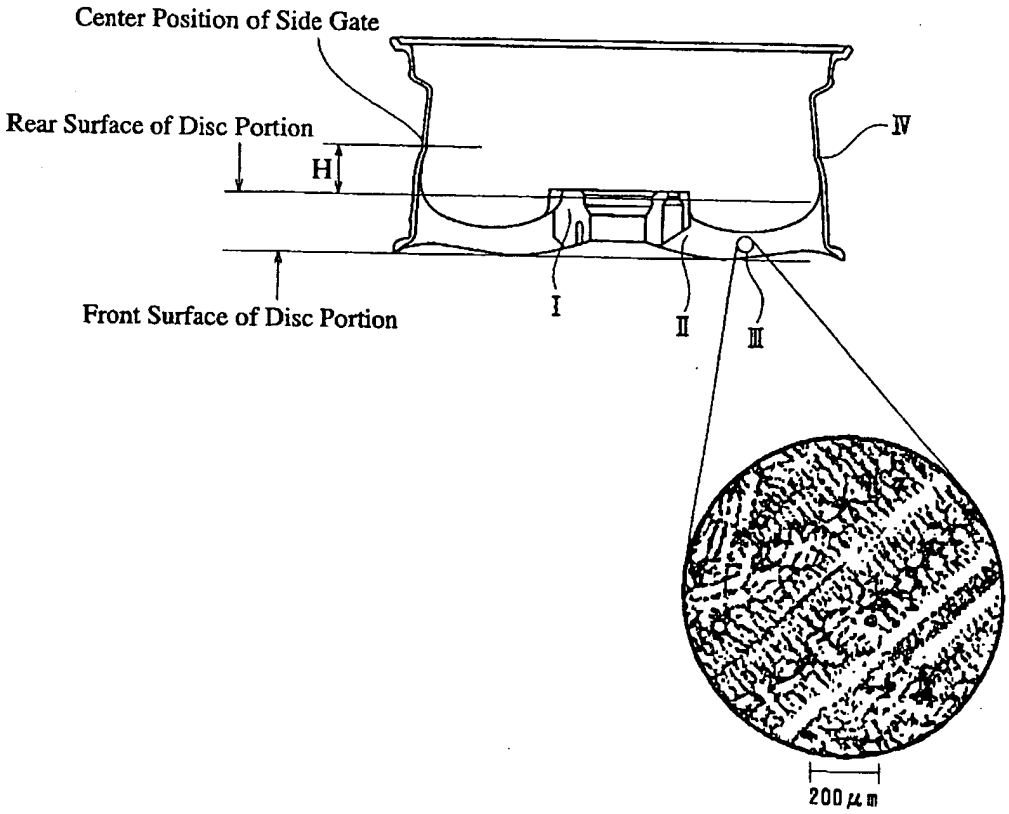

Fig. 20